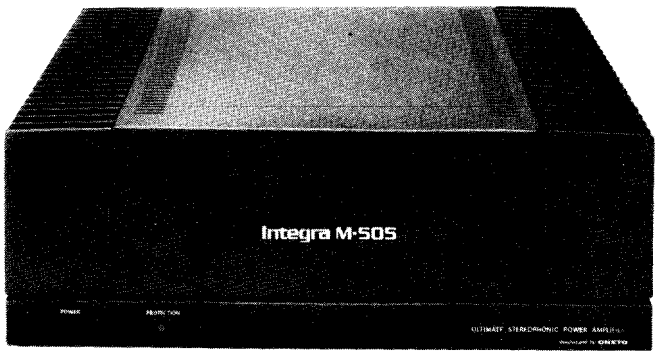
SERIAL **NO. 3036**

ONKYO® SERVICE MANUAL

ULTIMATE STEREOPHONIC POWER AMPLIFIER Model M-505



SPECIFICATIONS

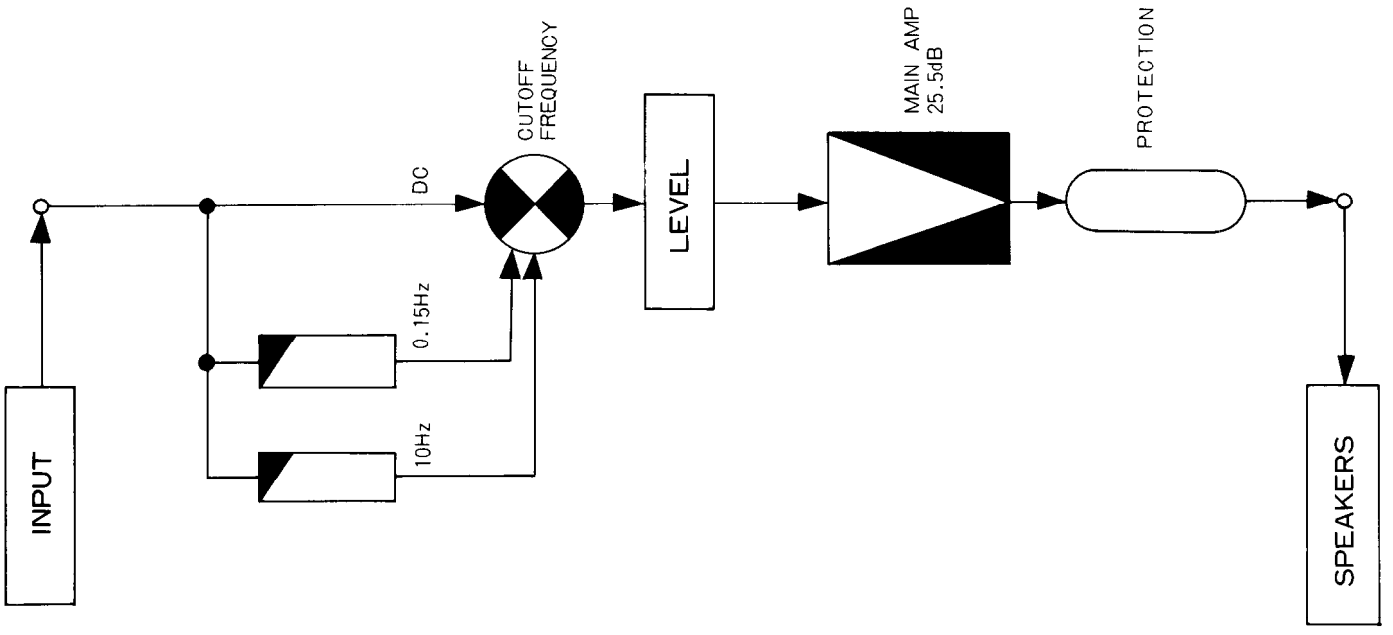
Power Output	140 watts perchannel, min RMS, at 4 ohms both channels driven, from 20 Hz to 20 kHz, with no more than 0.05% total harmonic distortion. 105 watts perchannel, min, RMS, at 8 ohms both channels driven, from 20 Hz to 20kHz, with no more than 0.05% total harmonic distortion.
Total harmonic Distortion	0.05 % at Rated power 0.02 % at 1 watt output
Intermodulation Distortion	0.01 % at Rated power
Gain	25.5 dB at 1 kHz
Frequency Response	+0, −1.5 dB at DC-150 kHz
Input Sensitivity	1.5 V
Input Impedance	100 kΩ
Load Impedance	4−16 Ω
Damping Factor	100 (8 Ω, 1 kHz)
Filter	0.15 Hz/10 Hz 6 dB/oct.
Signal to Noise Ratio	110 dB (IHF A NETWORK)

Power Output	
Dynamic	600 watts total at 4 ohms 0.05 % THD. 320 watts total at 8 ohms 0.05 % THD.
Continuous	165 watts per channel, at 4 ohms, 1 kHz 0.05 % THD 110 watts per channel, at 8 ohms, 1 kHz 0.05 % THD
Power Supply Rating	AC 120 V 60 Hz or AC 220 V 50 Hz
Controls	POWER CUTOFF FREQUENCY SELECTOR (DC, 0.15 Hz, 10 Hz) Rear Panel LEVEL ADJUSTER (L, R) Rear Panel
Outputs	SPEAKERS
Inputs	INPUT Terminals
Semiconductors	2 FETs, 45 Transistors, 31 Diodes
Dim ensions	450 W (17-3/4") x 165 H (6-1/2") x 322 D (12 11/16")
Weight	17 kg. (37.4 lbs.)

Specifications are subject to change without notice

ONKYO®
AUDIO COMPONENTS

BLOCK DIAGRAM



ALIGNMENT

1. IDLING CURRENT ADJUSTMENT
   Connect the DC voltmeter between IID and V CT terminals.
   Adjust the voltage to 12mV with R218. (Left channel)
   Adjust the voltage to 12mV with R318. (Right channel)
2. CENTER VOLTAGE ADJUSTMENT
   Connect the DC voltmeter between V CT and E terminals.
   Adjust the voltage to 0mV with R265. (Left channel)
   Adjust the voltage to 0mV with R365. (Right channel)

NOTES: Adjust after switching on for 10 minutes.

SERVICE POINTS

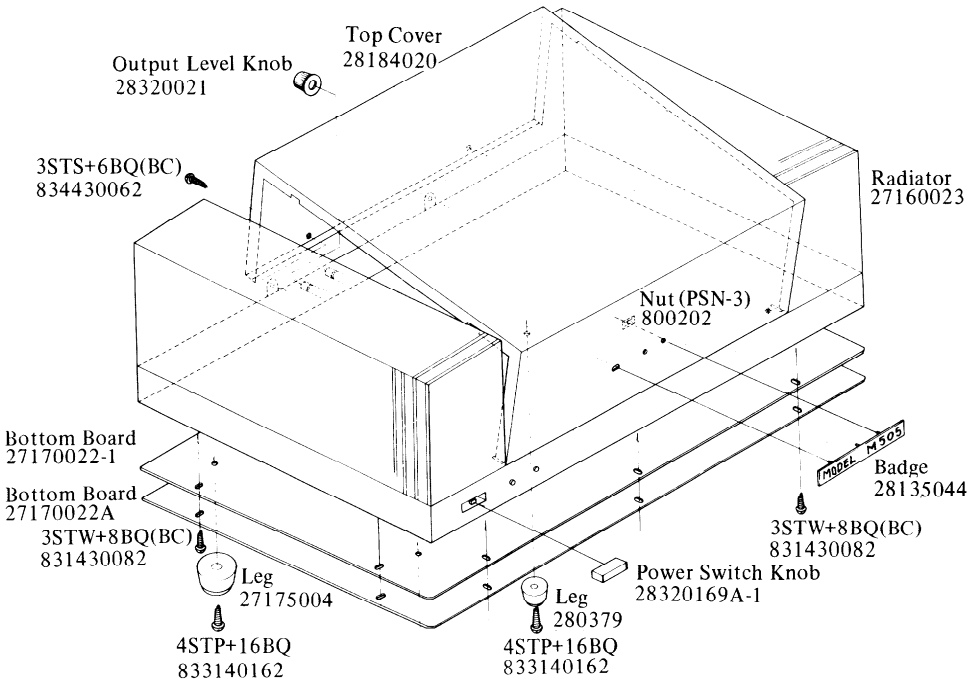
1. The protection circuit may also be activated by minute DC leaks, and very low frequency "clicks" generated in other equipment (such as preamplifier, divider, tuner, tape recorder) connected to the M-505. To avoid this, employ the following methods:–

a. Switch the CUT OFF FREQUENCY selector to 10Hz.
b. Switch on the power supply of all other connected equipment before switching on the M–505 (and waiting at least 5 seconds before doing so). When switching off again, switch off the M-505 first.
c. On the other hand, if the click generating equipment is turned on at the same time as the M-505 (for example, when using the SWITCHED outlet of the preamplifier) the transient killer circuit will prevent the passage of click signals. This method is in common use (but it is necessary to check the voltage of the outlet).

Note: When the M-505 is being used as a DC amplifier in combination with other equipment, check for the presence of DC input signals from the other equipment in the following manner:– first turn on the power supply for the M–505, and raise the LEVEL VR up from 0 to about 60° Then turn on the power supply of the other equipment. Any considerable vibration in the woofer cone, or PROTECTION operation, indicates the presence of a DC input signal. Either CUT OFF FREQUENCY position (0.15Hz or 10Hz) may be used in this case. After ascertaining the absence of any abnormalities, turn the LEVEL VR full around in the clockwise direction. Refer to the accompanying graph for CUTOFF FREQUENCY characteristic curves.

2. When replacing diffrential amplifier or push–pull amplifier transistors, be sure that transistors of one channel have the same hFE ratings.

EXPLODED VIEW



PARTS LIST

CIRCUIT NO.	120V Model PARTS NO.	DESCRIPTION	CIRCUIT NO.	220V Model PARTS NO.	DESCRIPTION
	12846589	NASW–389, Switch and Level Control PC Board		12846589	NASW–389, Switch and Level Control PC Board
	12846590	NADA–390, Main Amp. PC Board		12846590	NADA–390, Main Amp. PC Board
	12846591	NAPC–391, Protection Circuit PC Board		12846591	NAPC–391, Protection Circuit PC Board
Q001–Q004	2200423 or 2200422	2SD425(O) or 2SD425(R), Power Amp. Transistor	Q001–Q004	2200423 or 2200422	2SD425(O) or 2SD425(R), Power Amp. Transistor
Q005–Q008	2200433 or 2200432	2SB555(O) or 2SB555(R), Power Amp. Transistor	Q005–Q008	2200433 or 2200432	2SB555(O) or 2SB555(R), Power Amp. Transistor
D001	223802 or 223839	1S1885 or 1N4002, Silicon Diode	D001	223802 or 223839	1S1885 or 1N4002, Silicon Diode
PL001	210015A	50mA 6.3V, Power Indicator Light	PL001	210015A	50mA 6.3V, Power Indicator Light
PL003	210015A	50mA 6.3V, Protection Circuit Indicator Light	PL003	210015A	50mA 6.3V, Protection Circuit Indicator Light
T001. T002	230204	NPT–614D, Power Transformer	T001. T002	230205	NPT–614G, Power Transformer
C001–C004	3504091	18,000μF 75V, Elect. Capacitor	C001–C004	3504091	18,000μF 75V, Elect. Capacitor
C005	3504012	0.01μF 125V, UL Capacitor	C005	3500052	PME271Y510CEE, IS Capacitor
S001	25035015	NPS–111LA3, Power Switch	S001	25035015	NPS–111LA3, Power Switch
RL01	25065030	NRL–2P5A–DC12–01, Speaker Relay	RL01	25065030	NRL–2P5A–DC12–01, Speaker Relay
P001	270665	GND Terminal	P001	270665	GND Terminal
P002	25060024	NTM–4PRMN02, Input Terminals	P002	25060024	NTM–4PRMN02, Input Terminals
F001. F002	252020	5A–T, AC Fuse	F001. F002	252003	3A–T, AC Fuse
	25050016	Fuse Holder for AC Fuse		25050016	Fuse Holder for AC Fuse
	25108002	MD2R, Lug Plate		25108002	MD2R, Lug Plate
	253091	AS–UC–2, Power Supply Cord		253091	AS–UC–2, Power Supply Cord
	270280	SR–4K–4, Strainrelief		270280	SR–4K–4, Strainrelief
	25050017	M1609, Power Amp. Transistor Socket		25050017	M1609, Power Amp. Transistor Socket
A003	27160023	Radiator	A003	27160023	Radiator
A010	27267019	Guide for Power Switch Knob	A010	27267019	Guide for Power Switch Knob
A016	28184020	Amp. Cover	A016	28184020	Amp. Cover
A025	28135044	Model Badge	A025	28135044	Model Badge
A027	28198505	Facet (Green)	A027	28198505	Facet (Green)
A028	28198506	Facet (Red)	A028	28198506	Facet (Red)
A030	27170022A	Bottom Board (Lower)	A030	27170022A	Bottom Board (Lower)
A031	27175004	Leg	A031	27175004	Leg
A032	280379	Leg (Center)	A032	280379	Leg (Center)
A033	27170022–1	Bottom Board (Upper)	A033	27170022–1	Bottom Board (Upper)
A036	27320169A–1	Power Switch Knob	A036	27320169A–1	Power Switch Knob
A037	28320021	Level Control Knob	A037	28320021	Level Control Knob

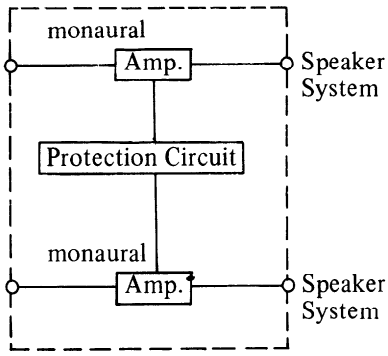
CIRCUIT DESCRIPTION

1. General Circuitry

The model M–505 power amplifier is a DC amplifier. Very low frequencies (0.15Hz and 10Hz) can be cut out by the CUT OFF selector. As the block diagram in Fig.1 indicates, the M–505 consists of 2 completely independent monaural amplifiers, even including the power supplies. (This is known as the dual line construction, or DLC design).

Further improvements have been achieved in reduction of dynamic modulation due to the use of copper plate bus lines for both ground and power supply. Super–low impedance has been obtained by the use of extremely thick connections to the power supply section. Together with the heavy–duty chemical capacitors, low impedance, low distortion, and low loss components have all contributed to greater stability in the high quality of sound.

Being a DC amplifier, even very small DC variations in the input will be amplified, and appear at the output. So the suppression of noise and drift in the low frequency range is very important indeed. Consequently, a low–noise dual–gate FET differential input has been employed (see Fig.2).



Fig–1

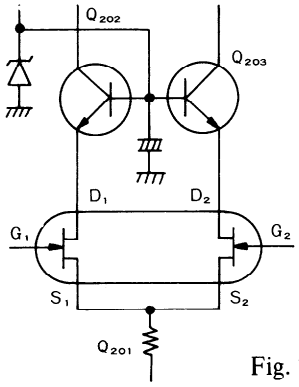


Fig. 2

The cause for drift in FETs can be traced to a thermal coefficient for the V_{GS} voltage across gate and source. Although there is a position where the operational point is unaffected by temperature changes when the drain current I_D is flowing, the gm of such a point decreases, and no gain is obtained. Therefore, 2 FETs of matched characteristics are coupled in a differential connection, thus cancelling out the drift tendencies. Employing FETs in this manner makes it relatively simple to construct DC amplifiers because there is very little input leak current (which corresponds to the I_B current in transistors).

The transistors Q202 and Q203 (and Q302 and Q303) connected to the drains of the FETs, constitute current mirror loads for the FETs, which, together with the emitter–follower in the next stage, considerably improve the frequency response in the high frequency region. These transistors also serve as loads to provide the FET operating voltage, so special care is required to avoid shorting them since this could quite easily damage the FETs.

Q205 and Q206 (and Q305 and Q306) are the emitter–followers used in impedance switching. The 2–stage differential amplifier, formed by Q207 and Q208 (Q307/Q308) with Q201 (Q301), reduces drift, and improves CMMR (Common Mode Rejection Ratio). (CMMR refers to the suppression of inputs of the same phase, and is expressed in dB. That is, CMMR = 20 log (differential input gain / same phase input gain). The bias compensation circuit consists of Q408 and Q209 (Q409 and Q309) in a Darlington connection. Detection occurs at 2 points, viz. the power transistor and driver transistor, resulting in better response to bias changes during large changes in output power. The resultant distortion is very low indeed. The output circuit consists of a well matched pure complementary 3–stage Darlington connection with a parallel push–pull in the final stage.

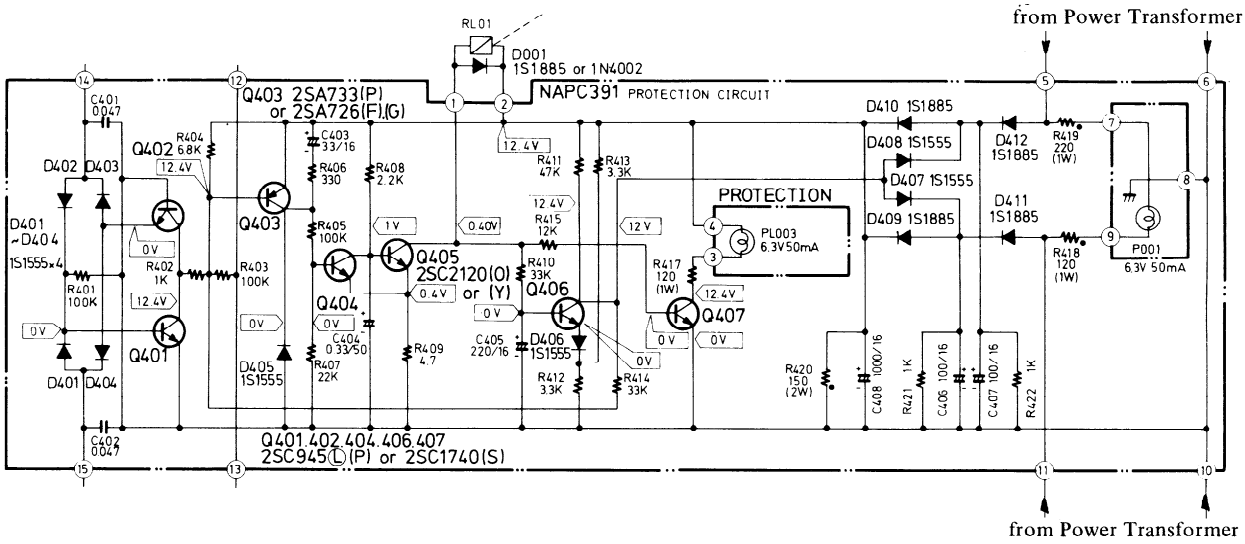


fig.3

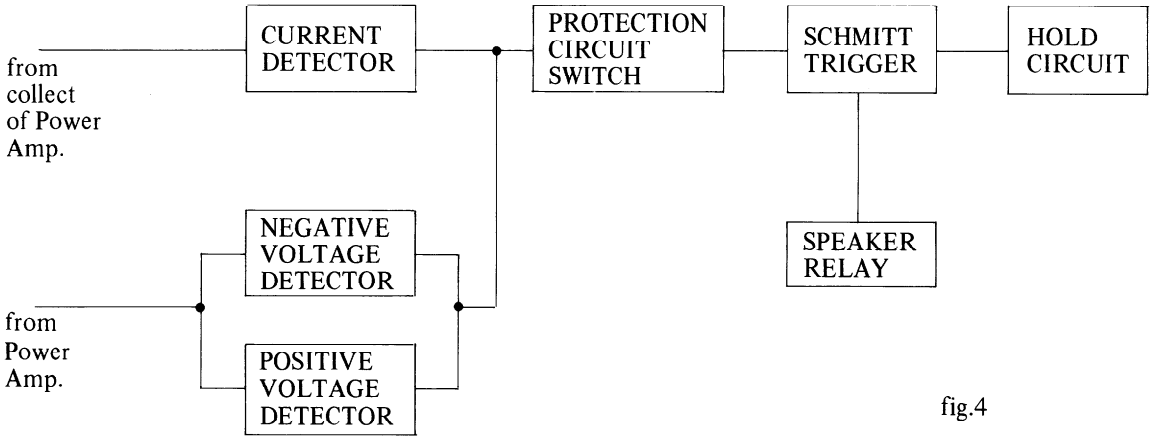


fig.4

Protection Circuit

The protection circuit is operated:

(1) when the B circuit is unstable when the power is turned ON (approximately 5 seconds)

(2) when the speaker terminals are shorted and abnormal current has flowed in the power amplifier thru this low impedance,

(3) when the center voltage has increased because of trouble at the differential amplifier, etc.

When Q403 is turned on by voltage detection or current detection, Q404 is turned ON by the voltage drop across R407. Q404, Q405 constitute a digitalized, fast response Schmitt trigger circuit. When Q404 is turned ON, Q405 is turned OFF. Q405 is a relay drive transistor. When it is turned OFF, the relay is also turned OFF.

When the power switch is turned ON, charging current flows thru the loop C403→R406→R405→R407 and Q404 is turned ON by the voltage drop across R407. Consequently, Q405 and the relay are turned OFF until the charging current drops below a certain value. When the power switch is turned OFF, the B voltage falls and C403 is quickly discharged thru the loop C403→R406→D405. During normal operation, C403 is charged to almost the B voltage. But since the saturation resistance of Q403 is sufficiently low, when Q403 is turned ON, C403 is quickly discharged thru the loop C403→R406→Q403 and the relay is also turned OFF. The relay is not turned ON again thereafter until C403 is charged, even if the set should return to normal and Q403 is turned OFF.

Hold Circuit

The reference voltage is produced by R413, R412. Q406 is operated as a comparator. When Q405 has been turned OFF, the collector voltage of Q405 rises and C405 is charged. Therefore, when C405 is charged to above a certain voltage relative to the reference voltage at the junction of R412 and R413, Q406 is turned ON, Q403 is turned ON thru R414 and the circuit is held.

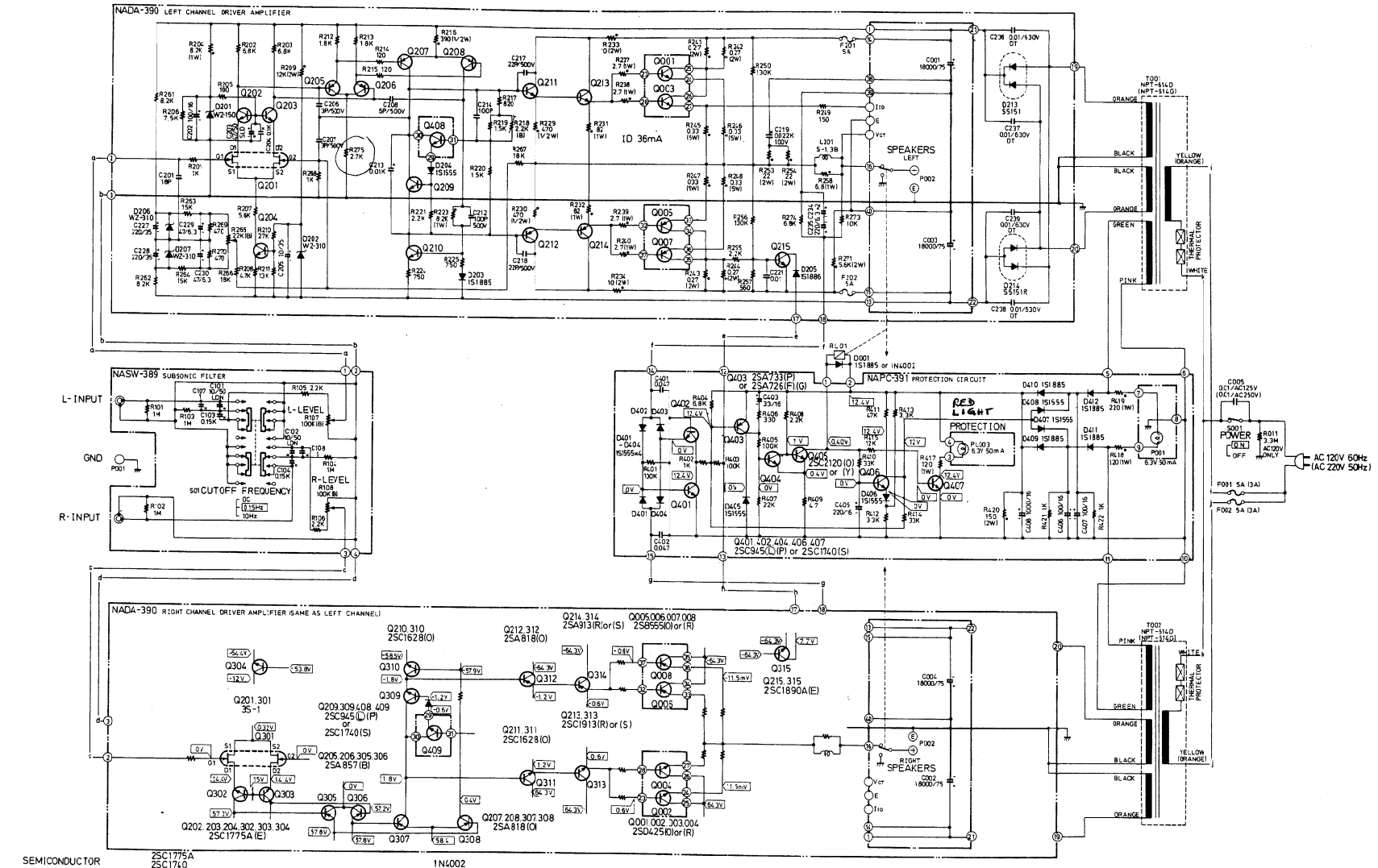
Current Detector

Q215 is turned ON by the voltage detected from the collector circuit of the power amplifier. C221 prevents erroneous operation.
When the impedance is low at a certain frequency of the speaker, the protection circuit may be unexpectediy actuated each time a large audio signal of that frequency has entered. However, when this occurs the relay is opened and the power amplifier current returns to normal. The power amplifier current is also automatically returned to normal in a like manner when the load has been inadvertently shorted momentarily. When connected with the load shorted, the relay is repeatediy turned ON and OFF in load short – relay OFF (no load) – automatic reset (load short current detection) – relay.OFF order. Since the OFF time is sufficiently longer than the relay ON time in this case, the voltage across C405 gradually increases until a voltage sufficient to turn Q406 is reached, at which time the relay is held OFF, thus protecting the power transistor against damage by a continuous overcurrent.

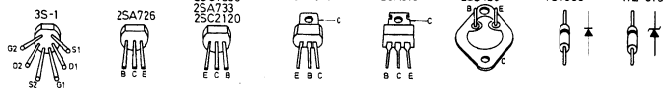
The power transformer

The voltage detection circuit is an OR circuit consisting of Q401, Q402. First, the Lch and Rch signals are mixed by D401, D402, D403, D404. When this voltage is negative, Q402 is turned ON and when this voltage is positive, Q401 is turned ON and the relay is turned OFF.
Since the center voltage is unrelated to ON–OFF of the load, when an abnormal voltage has been detected, the relay remains off and the hold circuit is operated until the voltage returns to normal. Once the hold circuit has been actuated it is not reset until the power has been turned back on after the cause of the trouble has been corrected.
The power transformers in both left and right channels are equipped with thermal switches, and, as an extra precautionary measure, special "thermal fuses". Any sudden abnormal temperature rise due to overload or failure, will result in the power supply being turned off.
To illustrate the sequence of events, it will be assumed that the left channel power transformer (in Fig.3) has been suddenly cut, which means no more AC will be applied to terminals 5 and 6. Under normal conditions, D411 and D412 operate as full wave rectifier, supplying the protection circuit of the high side power supply via the D409/D410 OR circuit. Once the left channel voltage drops, D411 of the right channel continues to operate as a half wave rectifier, with the protection circuit continuing to operate via this voltage. On the other hand, since C407 will discharge via R422, with current flowing from +B→R404→R414→D408→R422, The Q403 base potential will fall, Q403 and Q404 will turn ON, and Q405 turn OFF. The relay is thus switched off, disconnecting the speakers. And because the Q407 base potential increases, Q407 also turns ON, thus lighting up the protection indicator lamp.
The holding capacitor C405 is not charged up by the current flowing through R410→Q406 (B→C)→D408→R422. Therefore, Q406 will not turn ON, so when the left channel power supply is returned again, the same stand–by mode of operation as when the power supply is initially turned on, will be employed.
Note that the wiring to the transformer protection circuit terminals 5 – 6 and 10 – 11 are in the reverse right left order. If they are connected incorrectly, the 12.4V B voltage decreases, and the pilot lamp fails to come on.

MODEL M-505 SCHEMATIC DIAGRAM



SEMICONDUCTOR



NOTE 1. DC VOLTAGES (V) ARE MEASURED WITH V.T.V.M TO CHASSIS AT NO SIGNAL APPLIED.

2. UNLESS OTHERWISE SPECIFIED, RESISTORS ARE IN OHMS, ±5%, ¼W CAPACITORS ARE IN μF, 50V DC. ELECTROLYTIC CAPASITORS (—⊕—) ARE IN μF/WV.

3. TOLERANCE

SYM.	J	K	M	P	Z	D	F
TOL.	±5%	±10%	±20%	+100% - 0%	+80% -20%	±0.5pF	±1pF

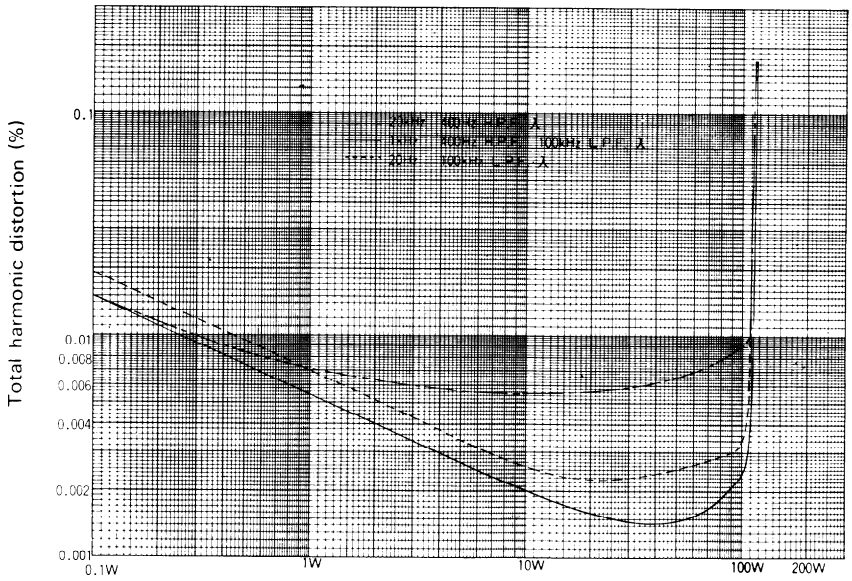
4. SYMBOL
× NON-INDUCTIVE POLYESTER FILM CAPACITOR
● NON-INFLAMMABLE RESISTOR

5. ( ) FOR AC 220V 50Hz TYPE.

RESPONSE CHARACTERISTICS

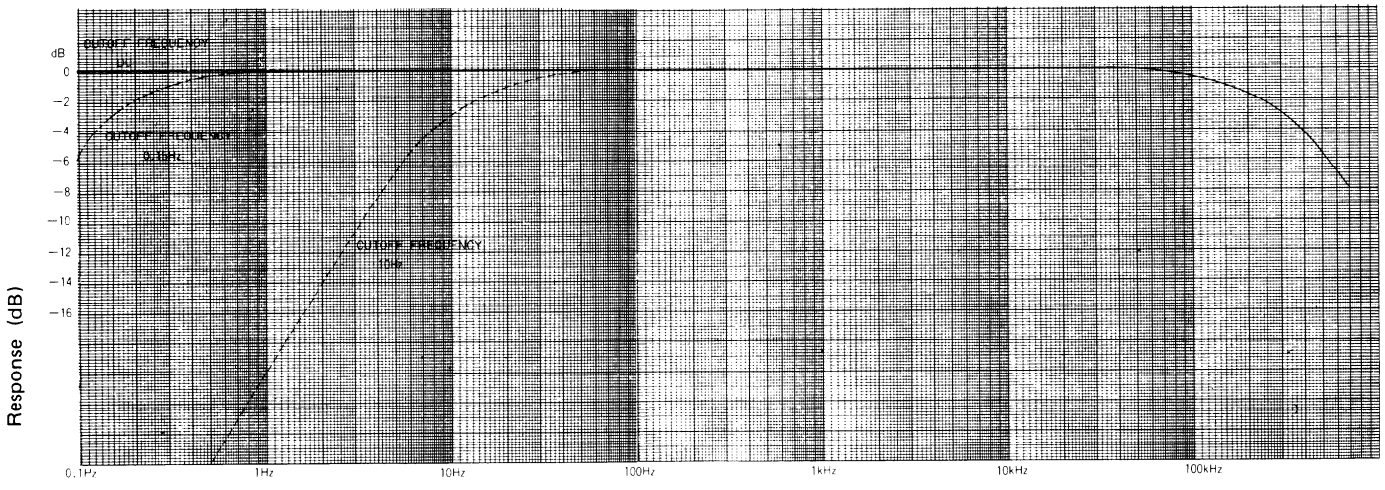
Output vs. Total harmonic distortion

8Ω load

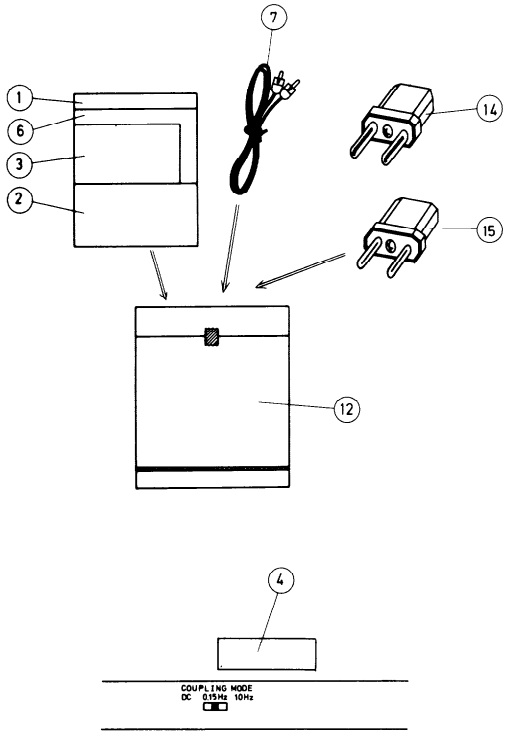


Frequency Response

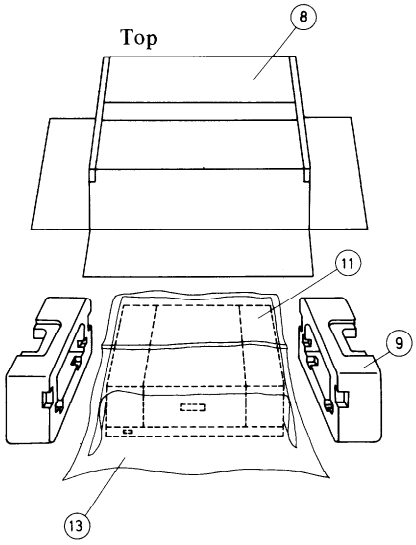
8Ω load 1V output level

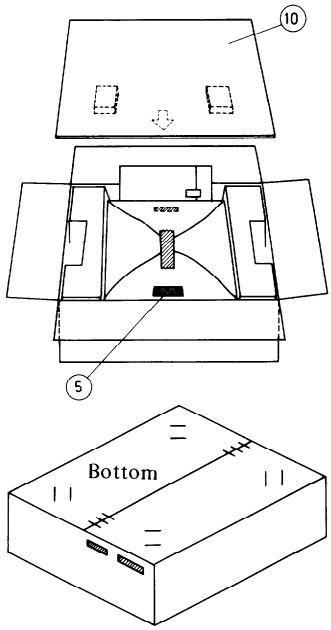


PACKING PROCEDURES



The coupling mode switch is set to "0.15Hz".





PARTS LIST

REF. NO.	DESCRIPTION	PARTS NO.			
		U.S.A.	UD	Germany	UG
1	Instruction manual	29340233	29340233	29340233	29340233
2	Warranty card	29365003	none	29365001–1	none
3	Caution card for 2	29355046	none	none	none
4	Caution label Λ	282969	282969	none	none
5	Caution label	293041	293041	none	none
6	Service station list	27358001	none	none	none
7	Connection cord	24505014	24505014	24505014	24505014
8	Carton box	29050145	29050145	29050145	29050145
9	Pad	29090181	29090181	29090181	29090181
10	Pad D	29090183	29090183	29090183	29090183
11	500X1,000mm, Protection sheet	290008	290008	290008	290008
12	350X250mm, Poly bag	29100006	29100006	29100006	29100006
13	850X550mm, Poly bag	29100019	29100019	29100019	29100019
14	CV–C, Conversion plug	none	none	292005	292005
15	CV–BS, Conversion plug	none	none	none	292006

ONKYO CORPORATION

International Division: No. 24 Mori Bldg., 23-5, 3-chome, Nishi-Shinbashi, Minato-ku, Tokyo, Japan.
Telex 2423551 ONKYO J. Phone 03-432-6981

ONKYO U.S.A. CORPORATION

Eastern Office
42-07 20th Avenue, Long Island City, New York 11105, U.S.A. Telex (TWX) 7105825459 Phone (212) 728-4639

Midwest Office
935 Sivert Drive, Wood Dale, Illinois 60191, U.S.A. Phone (312) 595-2970

ONKYO DEUTSCHLAND GMBH, ELECTRONICS
8034 München-Germering, Industriestrasse 18, West Germany. Telex 521726 Telefon (089) 84 50 41